PALEONTOLOGY—Woodringina, *a new foraminiferal genus (Heterohelicidae) from the Paleocene of Alabama*.

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In the course of investigations of the planktonic species of Foraminifera occurring in the Paleocene strata of the Gulf and Atlantic Coastal Plains, a distinctive and minute species was obtained from the Pine Barren member of the Clayton formation of Alabama. Although tiny, the relative abundance and distinctive characters of this species suggest that it may prove valuable as an horizon marker for strata of early Midway age. These distinctive characters necessitate the proposal of both new generic and specific names to accommodate this form.

Family HETEROHELICIDAE Cushman, 1927

Woodringina Loeblich and Tappan, n. gen.

Type species.—*Woodringina claytonensis* Loeblich and Tappan, n. gen., n. sp.

Test free, early stage with a single whorl of three chambers, followed by a biserial stage; chambers inflated; wall calcareous, radial in structure, finely perforate; aperture a low arched slit, bordered above by a slight lip.

Remarks.—*Woodringina*, n. gen. differs from *Tosaia* Takayanagi in having a much reduced early coil consisting of a single whorl of three chambers, whereas *Tosaia* has an early trochoid stage followed by a triserial and finally a reduced biserial stage.

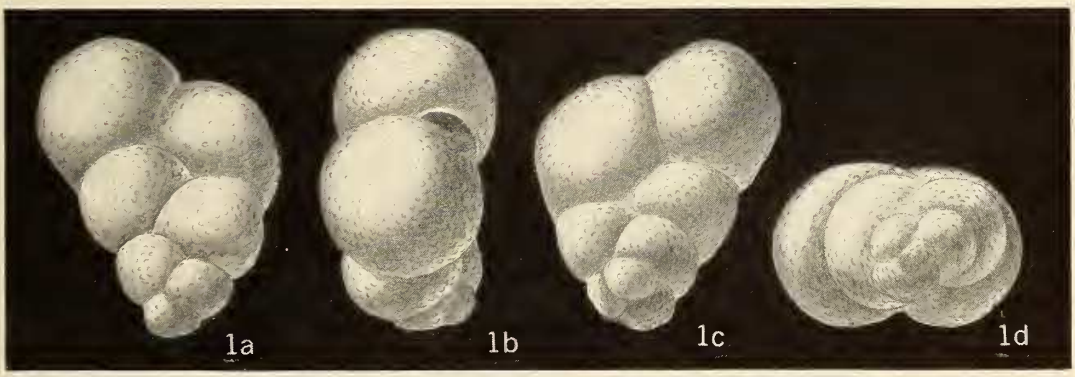
It superficially resembles *Heterohelix* Ehrenberg, but has a reduced "triserial" stage and lacks the early planispiral stage of that genus. It has a low slitlike aperture instead of a high, arched, and open one. *Chiloguembelina* Loeblich and Tappan has a high narrow aperture bordered with lateral flanges, and the test is wholly biserial.

The generic name is in honor of Dr. Wendell P. Woodring in recognition of his work on the Tertiary stratigraphy and paleontology and for his encouragement of micropaleontological studies in the Caribbean area.

Woodringina claytonensis Loeblich and Tappan, n. sp.

FIGS. 1, *a–d*

Test free, tiny, flaring rapidly; early stage with a single whorl of three chambers (reduced "triserial"), commonly followed by three, or more rarely up to five, pairs of biserial chambers, the plane of biseriality slightly twisted in development; chambers few in number, subglobular, increasing rapidly in size; sutures distinct, constricted; wall calcareous, finely perforate and very finely hispid; aperture a low, arched slit



FIGS. 1a–d.—*Woodringina claytonensis* Loeblich and Tappan, n. gen., n. sp: 1a, Side view of holotype, showing small test, appearing from this view to be biserial throughout; 1b, edge view, with specimen slightly tilted to show asymmetrical low arched aperture; 1c, opposite side, showing protruding third chamber above proloculus, which forms the reduced triserial stage of a single whorl, characteristic of this genus, and the later biserial stage; 1d, basal view, showing proloculus, single whorl of three chambered stage, and biserial later development. All × 280. Camera lucida drawings by Patricia Isham, scientific illustrator, U. S. National Museum.

bordered above by a slight lip, somewhat asymmetrical in position.

Length of holotype 0.15 mm, greatest breadth 0.12 mm. Other specimens range from 0.12 to 0.22 mm in length.

Remarks.—This species superficially resembles *Tosaia hanzawai* Takayanagi from the Pliocene of Japan, but differs in being about one-third as large, in having a reduced "triserial" stage of three chambers, and better developed biserial stage, whereas the Japanese form has a trochoid whorl, followed by a triserial stage, and only an occasional specimen has the poorly developed biserial stage. The chambers of the present species are also more inflated and subglobular.

Types and occurrence.—Holotype (U.S.N.M. P5685) from the Pine Barren member of the Clayton formation (Paleocene), blue-black micaceous clay exposed in road cut opposite small country store, 0.8 mile west of Alabama River bridge on Alabama State Highway 28, Wilcox County, Ala. Collected by Alfred R. Loeblich, Jr., July 1956.

EMISSION SPECTRA OF ACTINIUM

Detailed information about the configuration of electrons around the actinium nucleus has been obtained in a study of emission spectra of actinium recently completed by W. F. Meggers, chief of the National Bureau of Standards spectroscopy laboratory. The results also establish that the elements following actinium in the periodic table form a series of "rare earths" analogous to the series that follows lanthanum.[1] The spectrograms were made by M. Fred and F. S. Tomkins of the Argonne National Laboratory, and the actinium for the study was produced at the Argonne laboratory by transmuting radium.

Because of its low abundance, radioactive instability, and lack of commercial uses, actinium has never been concentrated in pure form from mineral sources. For a long time, therefore, little was known about its physical properties. The situation changed during the past decade when, after the discovery of nuclear fission and the construction of uranium piles, neutrons became available in sufficient quantities to produce ponderable amounts of any desired element by transmutation. Thus, several milligrams of actinium were made at the Argonne National Laboratory by bombarding radium with neutrons, thereby transmuting radium of atomic number 88 and mass 226 ($_{88}Ra^{226}$) to actinium of atomic number 89 and mass 227 ($_{89}Ac^{227}$).

Although actinium was artificially prepared primarily for chemical research, portions of the samples were loaned to physicists for investigation of the optical emission spectra. Because the Argonne laboratory was fully equipped with devices for the safe handling of "hot" materials, the actinium spectra were photographed there; the spectrograms were then shipped to the National Bureau of Standards, where they were measured and interpreted.

[1] For further technical details, see *The emission spectra of actinium*, by W. F. Meggers, M. Fred, and F. S. Tomkins, Journ. Res. NBS (in press).

EARLIER STUDIES

In 1899, André Debierne, assistant to Madame Curie, discovered a new chemical element in pitchblende. After chemically removing uranium, polonium, and radium, he found a residue 100,000 times more radioactive than uranium. He called this new element actinium.

After many years of research in radioactivity it has been established that actinium occurs in nature only as the daughter of protactinium, which in turn results from the spontaneous decay (emission of alpha and beta particles) of the relatively rare isotope of uranium, $_{92}U^{235}$—the isotope that produced the first atomic bomb. The half-life of actinium is only 22 years, and its unstable atoms quickly decay to a stable end product, actinium-lead ($_{82}Pb^{207}$). For this reason, the abundance of actinium in igneous rocks is only about 3×10^{-10} grams per metric ton, i.e., 3 parts in 10^{16}.

About thirty years ago the quantum theory of atomic spectra had developed to the point where all atomic and ionic spectra could be interpreted in terms of energy levels described by quantum numbers, and spectral terms were correlated with configurations of the outer (optical or valence) electrons. This provided a positive and practically unique method of determining the electronic structure of any and all atoms, thus giving meaning to the periodic arrangement of the chemical elements that the Russian chemist D. Mendeléef had proposed in 1869. The method could not be applied to actinium, however, until sufficient quantities of the pure element were available.

In the modern periodic chart of the atoms, scandium, yttrium, lanthanum, and actinium each occupy third place in the fourth, fifth, sixth, and seventh periods respectively. All have 3 electrons in the outer, unfilled "shells" and, consequently, have similar chemical properties. In the language of the chemist, they are homolo-